Enhancing the Capabilities of the Global Aerosol Monitoring Systems (GAMS)

Completed Technology Project (2016 - 2017)

Project Introduction

The Global Aerosol Measurement System (GAMS) project is developing a new, low cost satellite capability for measuring the properties and distributions of particles in the upper troposphere and lower stratosphere (collectively, the UTLS). This altitude region is important because there have been observed increases in the amount of particles in the UTLS. These particles typically reflect sunlight back into space and cool the Earth. GAMS will measure the altitudes and amounts of these particles by looking to the side of the spacecraft, through the thickness of Earth's atmosphere, and provide detailed information about how particles are changing in the UTLS.

The goal of the Global Aerosol Measurement System (GAMS) project is to develop needed technologies and observation strategies to optimally measure the distributions and properties of particles in the upper troposphere and lower stratosphere (UTLS). The GAMS concept is based on the limb-scattering measurement techniques used on past sensors, most directly from the heritage of the Ozone Mapping and Profiling Suite (OMPS) Limb Profiler (LP) currently flying on board the Suomi National Polar-orbiting Partnership (NPP) spacecraft. OMPS-LP was launched on Suomi NPP in 2011, with the next planned launch of this instrument in 2022 on the next generation Joint Polar Satellite System-2 (JPSS-2). Because of the length of time between the NPP and JPSS-2 launches there is the potential for a significant data gap for these important measurements. The GAMS concept is intended to be a simple and low cost measurement system that could be ready to fill such a gap.

The current OMPS-LP system measures light reflected by particles in the UTLS by looking behind the Suomi NPP path, looking through the thickness of Earth's atmosphere (i.e., the limb). Although OMPS-LP has proven capable of detecting the presence of background particles in the UTLS, as well as particles from volcanic eruptions and meteorites entering Earth's atmosphere from space, it has very limited spatial coverage and suffers from sensitivity issues since it preferentially sees particles in one direct with respect to the sun. GAMS seeks to overcome both limitations by making measurements of reflected light In two or more directions relative to the spacecraft flight. Because GAMS focuses only on the limb profiling capabilities (versus the more comprehensive but more complicated OMPS system) it can be contained in a relatively smaller spacecraft, which will reduce deployment costs. Additional increased spatial coverage can be realized by flying multiple copies of the GAMS instrument in different orbits.

In this stage of the GAMS project we are working to develop capabilities for adding additional spectral channels to our detector system. We initially targeting 350 nm for altitude registration and 675 nm for aerosol detection. We are now developing an extension to include an additional channel at 1020

This figure shows a laboratory bench assembly of a possible GAMS configuration, including viewing and optical path to detector assembly.

Table of Contents

Enhancing the Capabilities of the Global Aerosol Monitoring Systems (GAMS)

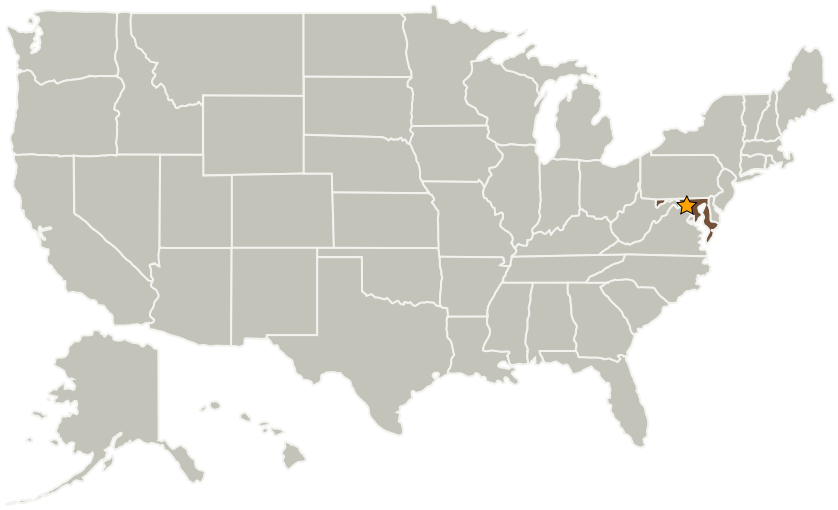
Completed Technology Project (2016 - 2017)

nm for aerosol detection. This channel will provide additional sensitivity to aerosol in the lower stratosphere, provides heritage overlap with other sensors (e.g., SAGE), and paired with the 675 nm channel provides additional information to recover other aspects of the aerosol distribution (e.g., particle size). We are additionally developing an observation simulator based on model output from the NASA Goddard Earth Observing System (GEOS-5) atmospheric model. This will allow us to prototype assimilation methodologies to ingest the eventual GAMS observations into aerosol prediction models.

Anticipated Benefits

The technologies developed in the Global Aerosol Measurement System (GAMS) project will lead to a more capable, low cost measurement system for monitoring the vertical distributions of particles in the UTLS.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations
Maryland

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Independent Research & Development: GSFC IRAD

Project Management

Program Manager:

Peter M Hughes

Project Managers:

Matthew J Mcgill
William E Cutlip

Principal Investigator:

Peter R Colarco

Co-Investigator:

Matthew T Deland

Enhancing the Capabilities of the Global Aerosol Monitoring Systems (GAMS)

Completed Technology Project (2016 - 2017)

Project Transitions

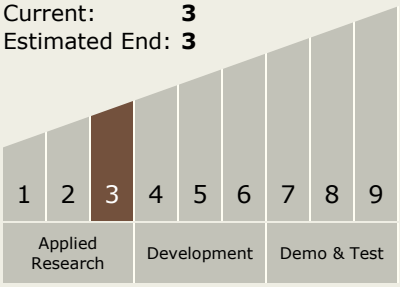
October 2016: Project Start

September 2017: Closed out

Closeout Summary: The purpose of the Goddard Space Flight Center's Internal Research and Development (IRAD) program is to support new technology development and to address scientific challenges. Each year, Principal Investigators (PIs) submit IRAD proposals and compete for funding for their development projects. Goddard's IRAD program supports eight Lines of Business: Astrophysics; Communications and Navigation; Cross-Cutting Technology and Capabilities; Earth Science; Heliophysics; Planetary Science; Science Small Satellites Technology; and Suborbital Platforms and Range Services.Task progress is evaluated twice a year at the Mid-term IRAD review and the end of the year. When the funding period has ended, the PIs compete again for IRAD funding or seek new sources of development and research funding or agree to external partnerships and collaborations. In some cases, when the development work has reached the appropriate Technology Readiness Level (TRL) level, the product is integrated into an actual NASA mission or used to support other government agencies. The technology may also be licensed out to the industry.The completion of a project does not necessarily indicate that the development work has stopped. The work could potentially continue in the future as a follow-on IRAD; or used in collaboration or partnership with Academia, Industry and other Government Agencies.If you are interested in partnering with NASA, see the TechPort Partnerships documentation available on the TechPort Help tab. http://techport.nasa.gov/help

Technology Maturity (TRL)

Start: **3**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors

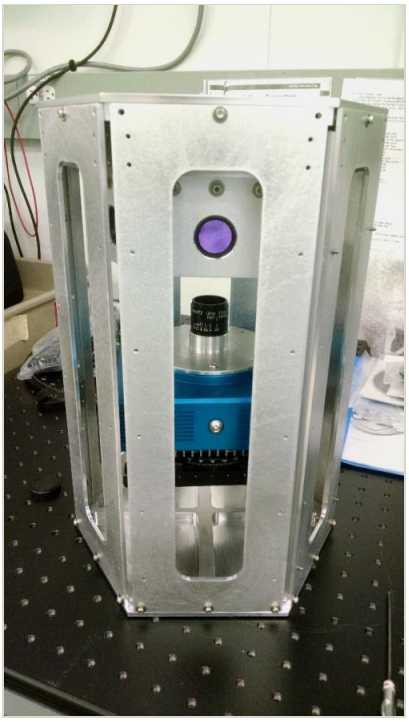
Target Destination

Earth

Enhancing the Capabilities of the Global Aerosol Monitoring Systems (GAMS)

Completed Technology Project (2016 - 2017)

Images



Prototype GAMS Assembly
This figure shows a laboratory bench assembly of a possible GAMS configuration, including viewing and optical path to detector assembly.
(https://techport.nasa.gov/image/26029)